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Forestry - Montana

FORESTRY AND WATER QUALITY

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FORESTRY and WATER QUALITY

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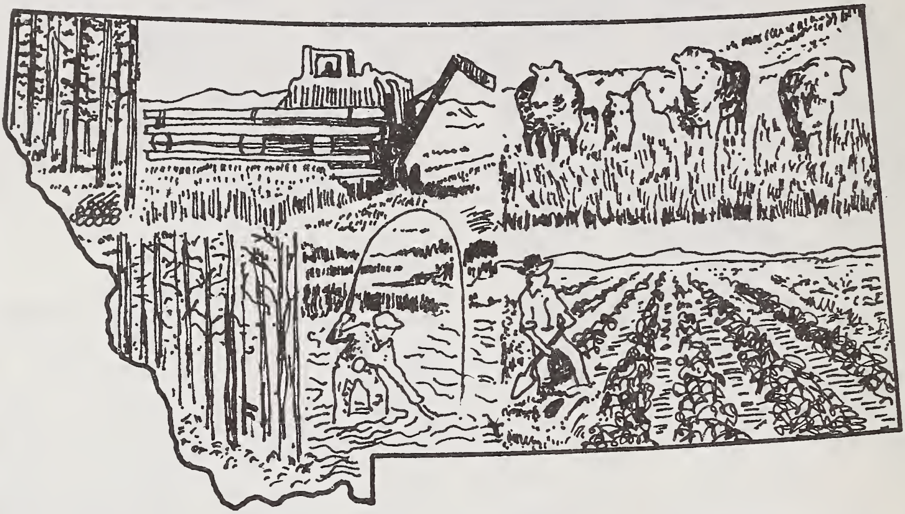
INTRODUCTION



WATER QUALITY; A BRIEF HISTORY

- 1948—national water quality policy established by Congress
- 1950's & 60's—Federal laws focus on point source pollution—pipes, ditches—in urban & industrial areas
- 1972—Federal Water Pollution Control Act (FWPCA) includes Section 208—"non-point" source pollution, such as sediment & wastes from farming & **forestry**
- 1972 FWPCA goal—make the nation's water fishable & swimmable
- 1975—Montana adopts Natural Streambed and Land Preservation Act (Senate Bill 310), which requires a 310 Permit when disturbing a perennial stream. Conservation Districts develop Best Management Practices (BMP's)
- 1981 & 1982—Montana's Water Quality Bureau & Division of Forestry cooperate in preparing a Forestry & Water Quality Training Program. This booklet is part of that program and it illustrates a number of common Best Management Practices for forestry.

WHAT CAUSES WATER POLLUTION?

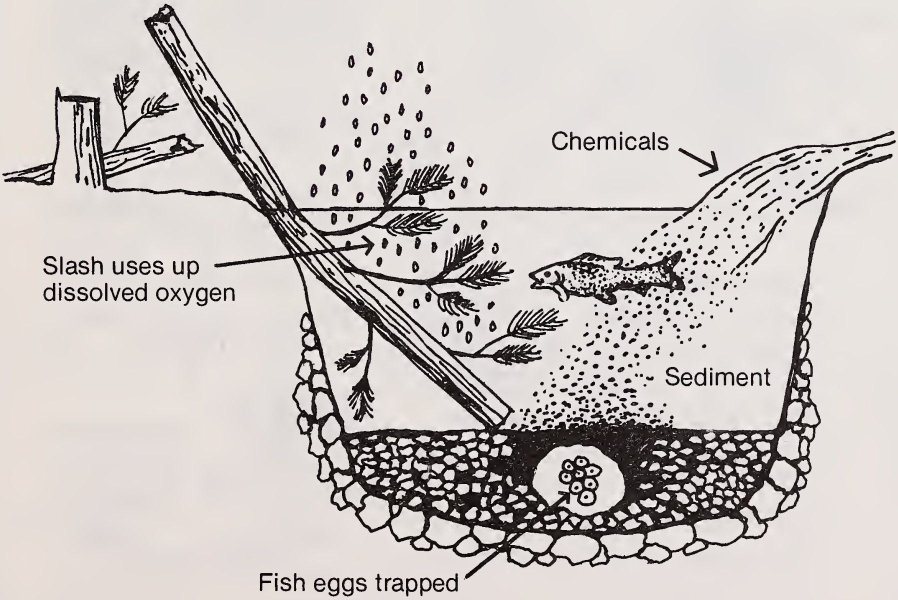
SOIL PARTICLES—up to 90% of man caused forest stream sediment is from roads

ORGANIC MATERIAL—Slash—trees, tops, limbs, & other logging debris

CHEMICALS—residues from fire retardants, pesticides, fertilizers, others

WHAT CAN WATER POLLUTION DO?

- Sediment clogs irrigation systems downstream
- Sediment covers & suffocates fish eggs
- Sediment affects natural beauty of streams & lakes
- Sediment & chemicals affect drinking water
- Chemicals are toxic to fish
- Decomposing slash removes oxygen needed by fish

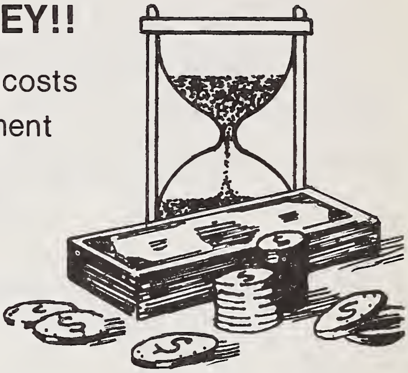


SOIL EROSION

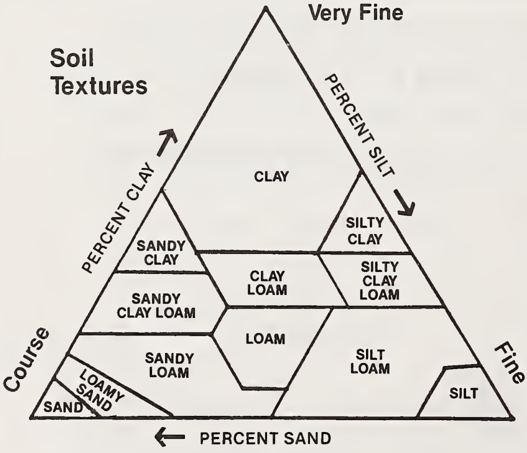
WHY PREVENT SOIL EROSION?

YOU SAVE TIME & MONEY!!

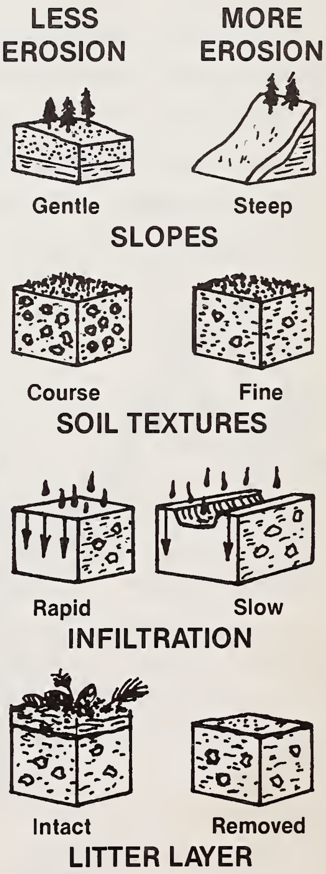
- Reduced road maintenance costs
- Less wear on your equipment
- Faster skidding & hauling
- Fewer production delays
- Haul roads can be reused
- Long term forest productivity
- Clean water for all uses



DO YOU KNOW YOUR SOILS?



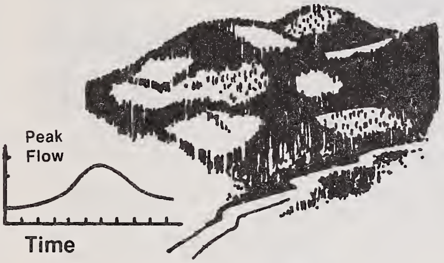
- Soils differ in erosivity
- Slope, soil texture, area of exposed mineral soil, rate of water infiltration and other factors affect soil erosion
- Road construction standards depend on soil erosiveness
- For information about soils in your area contact the local Conservation District



PLANNING FOR LOGGING

CONSIDER THE TOTAL WATERSHED & THE SEASON

- Coordinate the harvest within a drainage basin among the individual landowners
- Overcutting affects water quality, quantity, and peak flow conditions
- Operation on dry or frozen soils means efficient production, better roads, less road maintenance.



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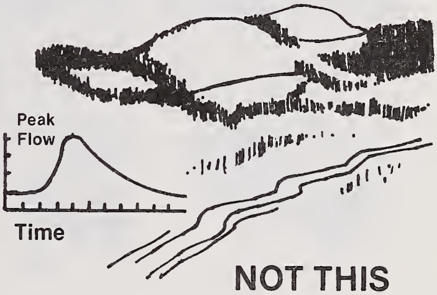

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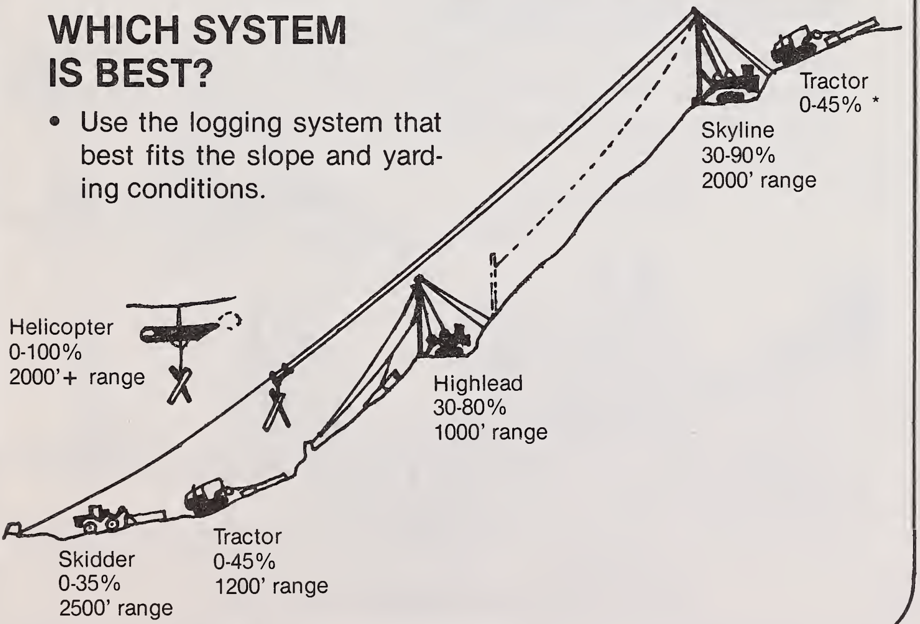
WHICH SYSTEM IS BEST?

- Use the logging system that best fits the slope and yarding conditions.



STREAMSIDE MANAGEMENT ZONE

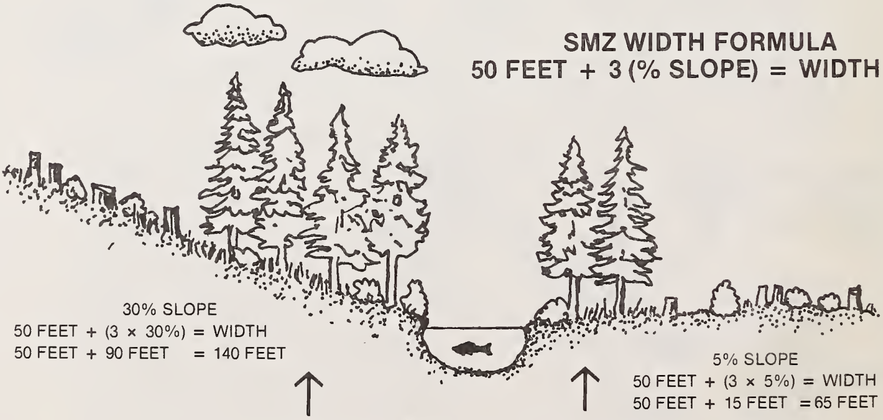
STREAMSIDE MANAGEMENT ZONES PROTECT WATER RESOURCES

The areas of vegetation bordering forest streams are known as streamside management zones or SMZs. If left in place, they can filter out sediment & debris in runoff, & minimize erosion of the stream channel. The steeper the slope, the wider this protective zone should be.

GUIDELINES FOR SMZ

Use the formula below to determine the width of a streamside management zone. Selected commercial trees can be cut in an SMZ if other trees & underbrush are left for protection.

SMZ WIDTH FORMULA
50 FEET + 3 (% SLOPE) = WIDTH



30% SLOPE
50 FEET + (3 × 30%) = WIDTH
50 FEET + 90 FEET = 140 FEET

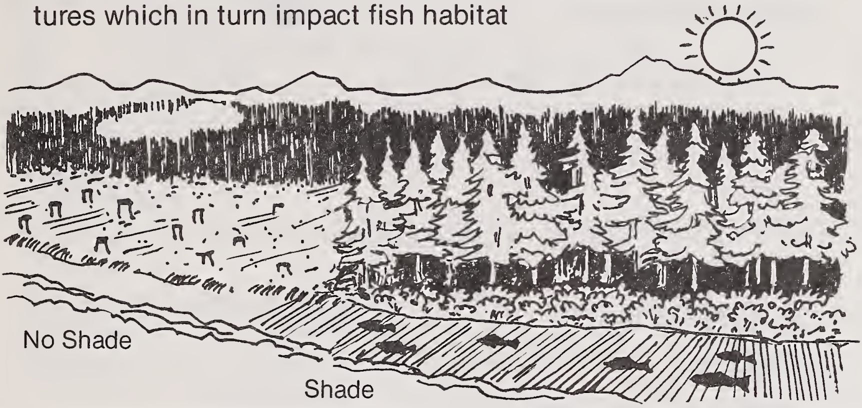
5% SLOPE
50 FEET + (3 × 5%) = WIDTH
50 FEET + 15 FEET = 65 FEET

Streamside Management Zone

STREAMSIDE MANAGEMENT ZONE

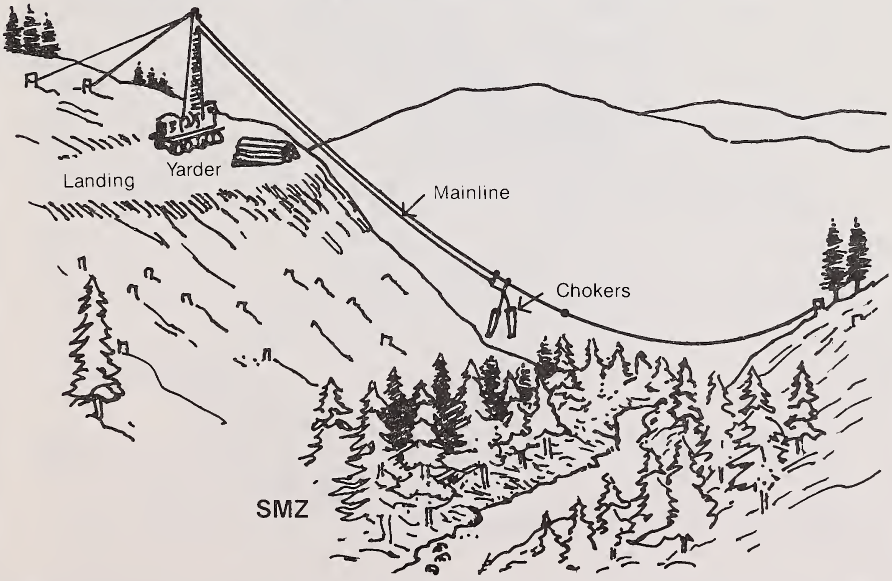
SMZ & STREAM TEMPERATURES

Removing stream shade from the SMZ can raise stream temperatures which in turn impact fish habitat



PROTECT THE STREAMSIDE MANAGEMENT ZONE

- Avoid equipment operations in the SMZ
- Use highlead or winches to remove logs
- Locate landings and roads outside the SMZ
- Protect the SMZ when doing prescribed burning of slash



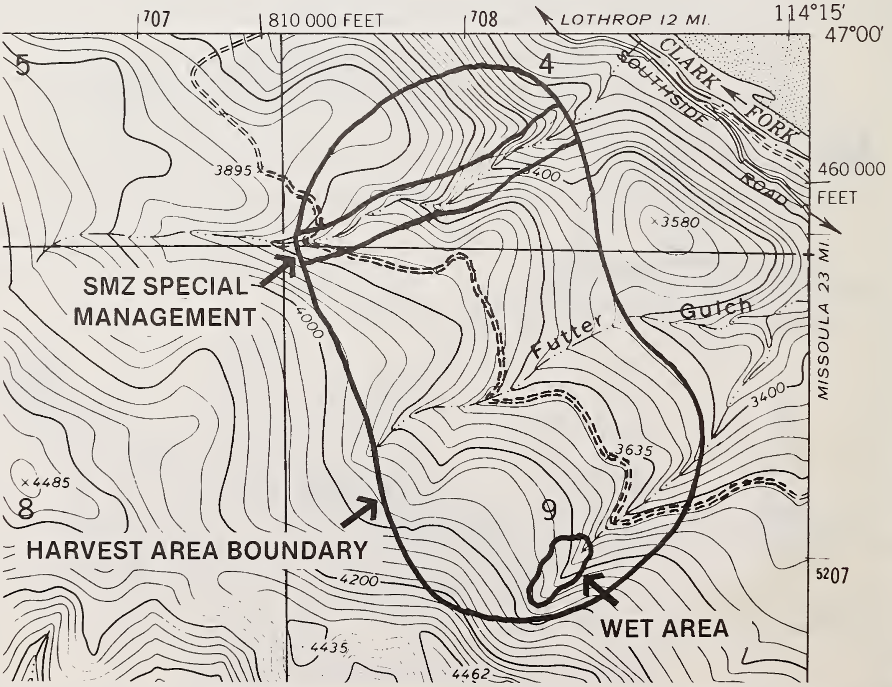
HOW TO PLAN A ROAD SYSTEM

GOOD PLANNING SAVES TIME AND MONEY

- Lay out roads, landings & stream crossings on paper before you make expensive mistakes on the ground

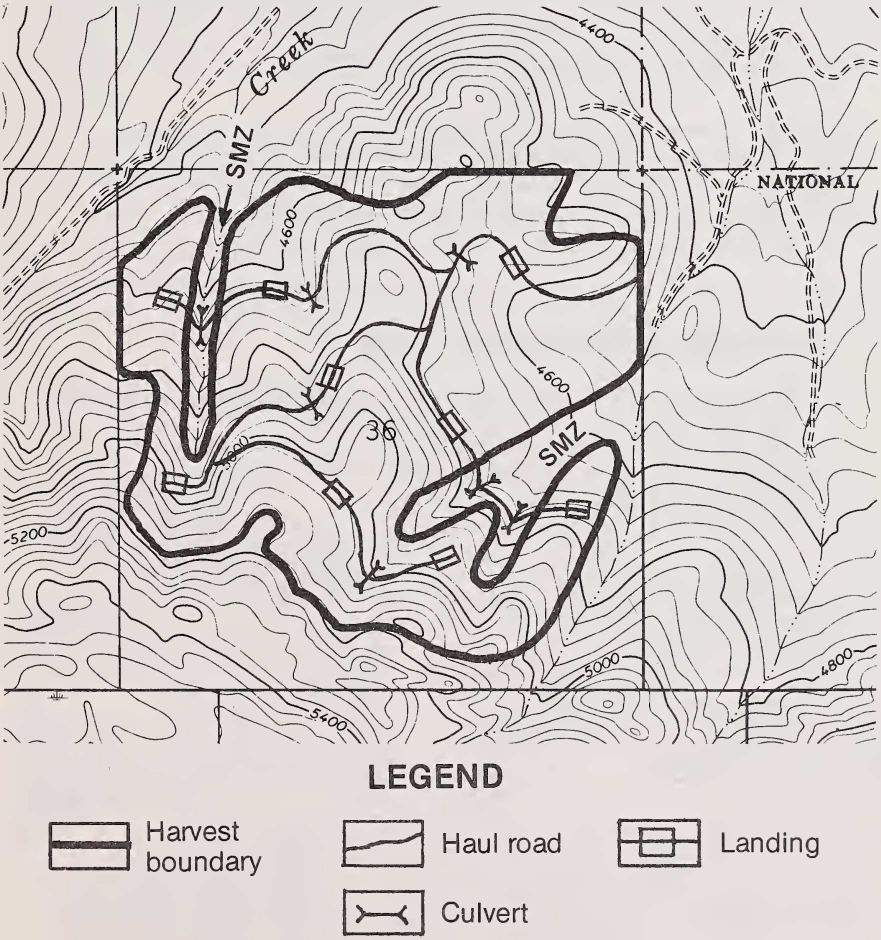
DESIGNING A GOOD ROAD LAYOUT

- Mark the boundaries of the harvest area on a topographic map
- Walk the area so you know the land & potential road locations
- Outline areas on the map that are wet, unstable, or in streamside management zones (SMZ)
- Draw different plans on tracing paper overlays and compare to find the best layout for this & future harvests



ROAD DESIGN GUIDELINES

- Keep stream crossings to a minimum
- Cross streams at right angles
- Direct the road out of the streamside management zone
- Put haul roads on high ground with easy grades
- Avoid sustained road grades over 10% and sharp bends
- Keep roads off wet or unstable soils
- Locate landings on flat or gently sloping ground with good drainage
- Keep landings away from streamside management zones and lakes
- Minimize road density

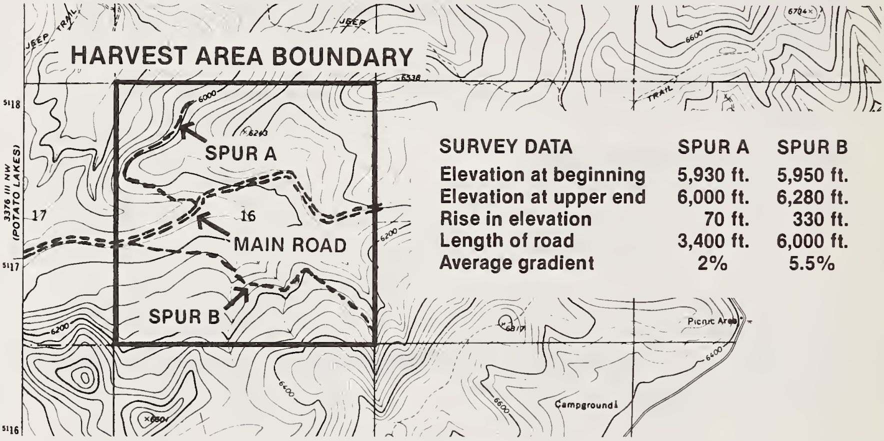


ROAD GRADES & LOADS

DETERMING ROAD GRADES

- Use contour lines & a ruler to determine elevation differences and distances
- Divide the difference in elevation by road length to find average grade

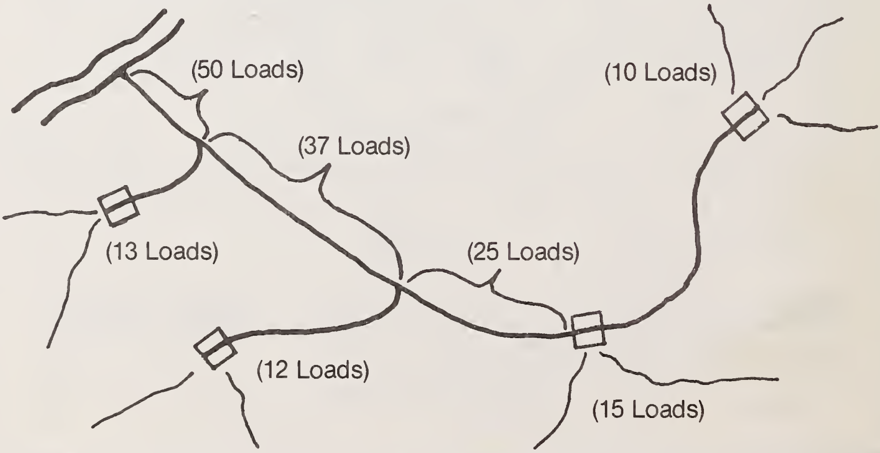
EXAMPLE: 330' ÷ 6,000' = .055 or 5.5%



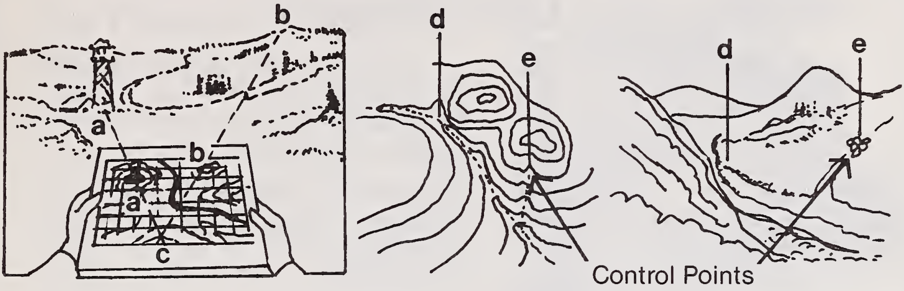
SURVEY DATA	SPUR A	SPUR B
Elevation at beginning	5,930 ft.	5,950 ft.
Elevation at upper end	6,000 ft.	6,280 ft.
Rise in elevation	70 ft.	330 ft.
Length of road	3,400 ft.	6,000 ft.
Average gradient	2%	5.5%

DETERMINING ROAD USE

- Divide estimated board feet per landing by estimated board feet per truck to find number of loads
- Number of loads crossing each road section determines amount of road use.



HOW TO LAYOUT ROADS

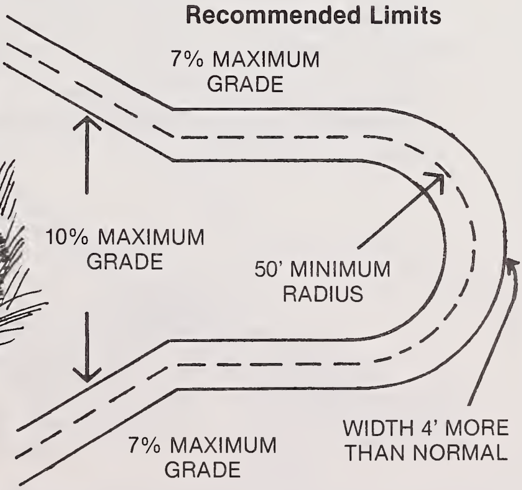


PUTTING YOUR PLAN ON THE GROUND

- Find “control” points on the map & on the ground; streams, rock outcrops, switchbacks, slides, boundaries, etc., places where the road must go and must not go
- Flag the rough road location using the control points to guide you
- Check skidding distances & mark landing areas
- Backtrack your flagged route & adjust to take advantage of natural features that make road building & drainage easier
- Check grades of the flagged route—less than 10% is best (10 foot rise every 100 feet)

SWITCHBACKS

Switchbacks are used to reduce road grades in steep terrain



ROAD CONSTRUCTION & DRAINAGE

MINIMIZE SOIL DISTURBANCE

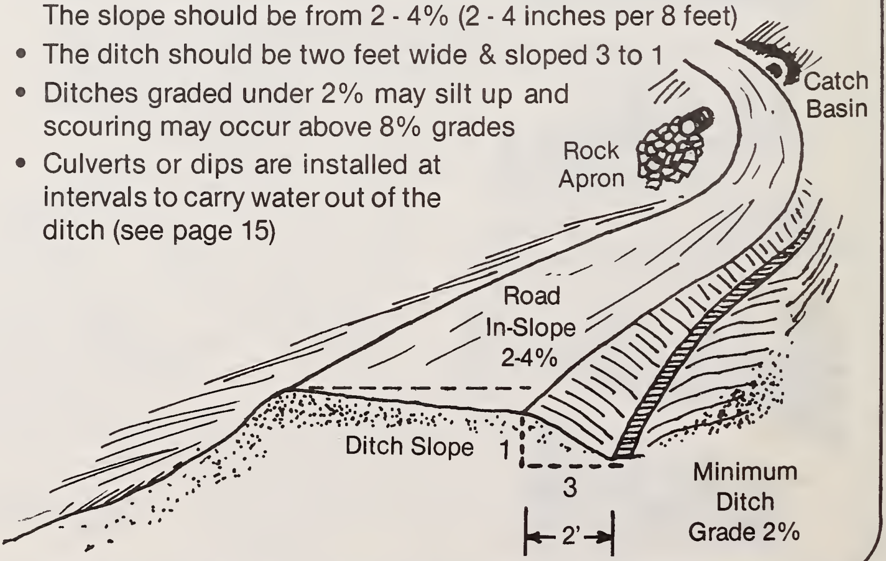
- Minimizing road width & length reduces erosion & leaves more land in production
- Construcion costs for 10-foot wide roads are lower than 14-foot wide roads

IN-SLOPE ROADS

In-sloping is cutting a road section to slope toward the inside edge of the road bed. A ditch carries away surface water. It is the most common method of reliable drainage for a permanent road

HOW TO IN-SLOPE

- In-sloping is preferred on unstable fill areas, erosive soils, steep turns or banks, and for safety in wet or icy conditions. The slope should be from 2 - 4% (2 - 4 inches per 8 feet)
- The ditch should be two feet wide & sloped 3 to 1
- Ditches graded under 2% may silt up and scouring may occur above 8% grades
- Culverts or dips are installed at intervals to carry water out of the ditch (see page 15)



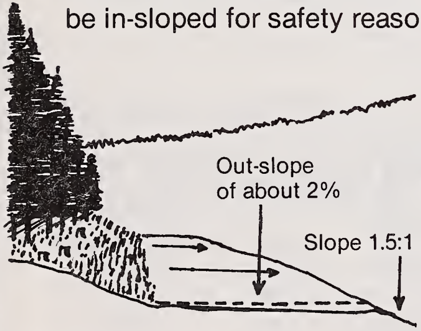
ROAD CONSTRUCTION & DRAINAGE

OUT-SLOPING HELPS MINIMIZE EROSION

Out-sloping means cutting a road section so that it slopes slightly from the cut bank to the outside edge of the road bed. This allows water to flow off the road and not build up in it. Do not out-slope on unstable fills or erodable soils.

HOW TO OUT-SLOPE

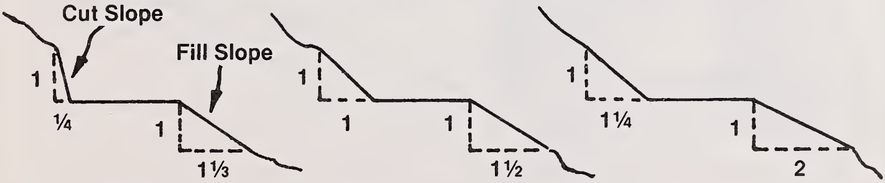
Out-sloping is usually done after logging is complete. However, you may out-slope on gently sloping roads during logging operations—but be careful; during winter conditions, the road should be in-sloped for safety reasons.



Out-sloping can be done with a grader, skidder blade, or dozer. The slope should be about 2% (2 inches per 8 feet), smooth, and all berms on the outside of the roadway must be removed.

Out-sloping, water bar installation, and seeding should be done together after logging is completed.

TYPICAL ROAD CROSS-SECTION



Typical stable cut & fill slopes for roads built in rock.

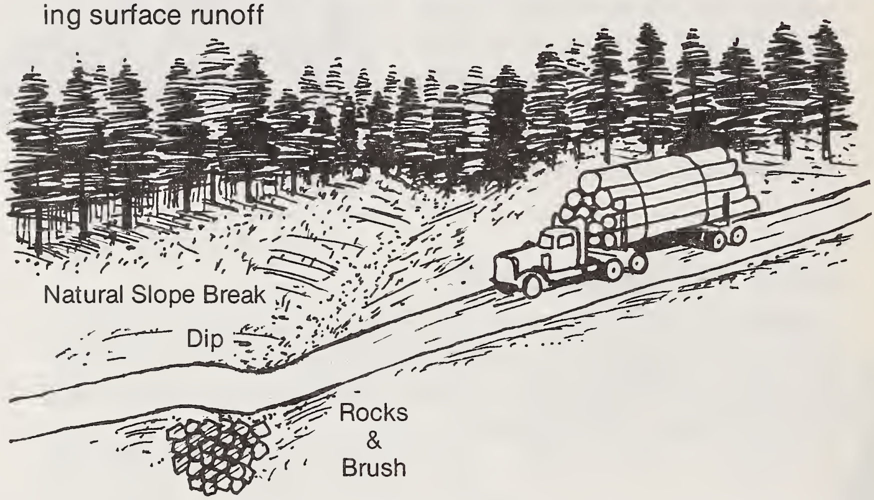
Typical stable cut and fill slopes for roads built in stable, common earth.

Typical stable cut and fill slopes for roads built on less stable slopes with water seepage.

ROAD CONSTRUCTION & DRAINAGE

ROLLING GRADE DIPS

On long grades a good method of road drainage is to construct reverse slopes or dips. They work best when they fit into natural slope breaks. Rolling grade dips maintain drivability, while draining surface runoff

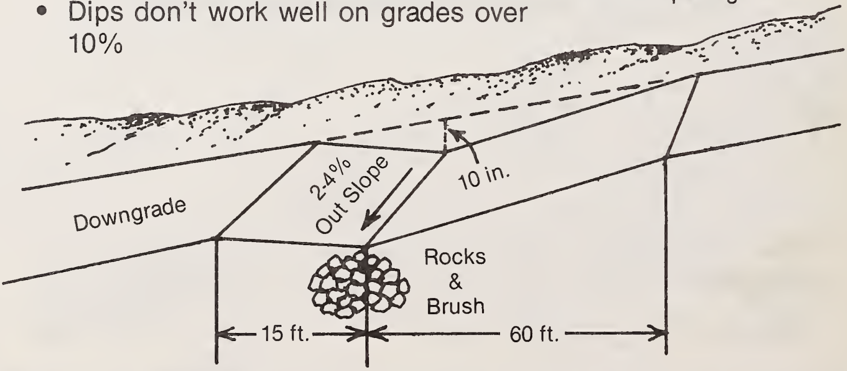


HOW TO CONSTRUCT ROLLING GRADE DIPS

- Excavate the dip while pioneering the road, or construct on existing roads so the slope is reversed
- Make sure the dip is out-sloped and a berm does not stop water flow
- Protect the drainage area with grass, brush, rocks or logs to reduce erosion
- Dips don't work well on grades over 10%

ROAD GRADE	MAXIMUM RECOMMENDED SPACING*
2%	300'
4%	200'
6%	170'
10%	140'

*Erodable soils require closer spacing



CULVERTS

WHEN CAN CLUVERTS BE USED?

DITCH RELIEF CULVERTS

- Use metal culverts for cross drainage of roadside ditches. Use this type of cross drainage on long, sloping roads and at the top and bottom of short, steep sectons of road
- Cross drainage should be located to avoid delivering drainage water directly to streams

STREAM CROSSING CULVERTS

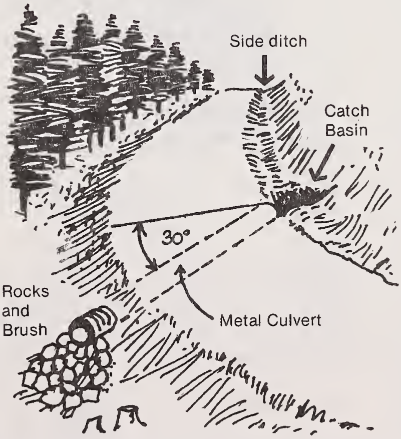
- Metal or concrete pipe culverts can be used under haul or skid roads to convey a stream under a crossing
- Minimum diameter recommendation is 18 inches—they require less maintenance and protect road investment

HOW TO INSTALL A CROSS DRAINAGE CULVERT UNDER A HAUL ROAD

- Determine where the cross drainage is needed after shaping the haul road
- Install the culvert at a 30 degree angle downslope
- Place the culvert at least 12 inches below grade and allow it to slope on natural grade
- Intercept water flowing in the ditch with a catch basin
- Extend the outlet end to base of fill, and empty onto an apron of rock, gravel, brush or logs
- Space the culverts according to the road grade and erodability.

MAXIMUM RECOMMENDED CULVERT SPACING

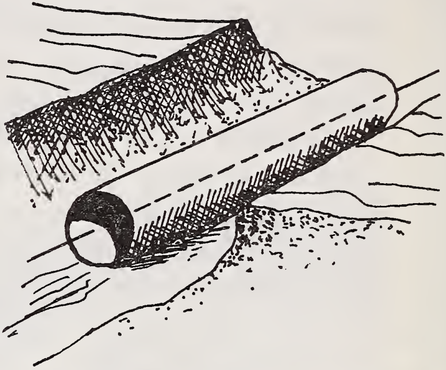
GRADE	ERODABILITY	
	Low	High
3%	—	1070’
4%	—	800’
5%	1200’	640’
6%	1000’	540’
8%	750’	400’
10%	600’	320’



CULVERTS

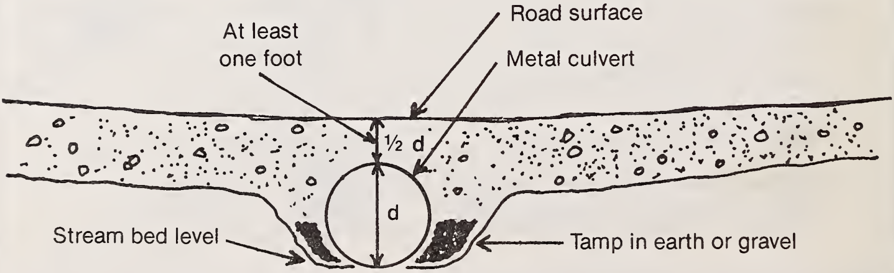
STREAM CROSSINGS

- Obtain a 310 Permit from your local Conservation District
- Cross streams at right angles whenever possible
- Lay culvert parallel to the stream gradient and in the center of the channel



HOW TO INSTALL A CULVERT IN A STREAM BED

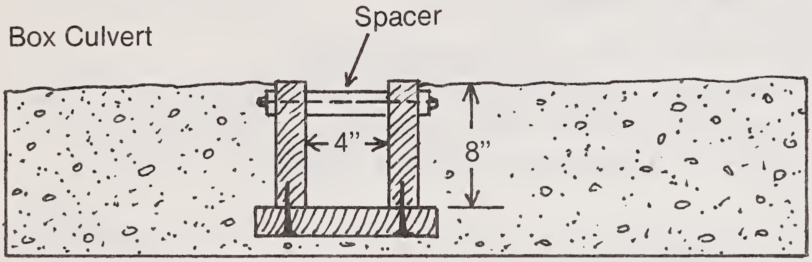
- Select a location that has firm banks and fairly level approaches
- Culvert sizes should handle expected peak runoff. Help in selecting proper culvert size can be obtained from the State Lands, Office, Soil Conservation Service, or the local Fish, Wildlife and Parks Office.
- Install the culvert so that:
  - —the bottom lies on or a little below the stream bed
  - —earth or gravel is tamped around at least half of the culvert for its full length
  - —the dirt covering the culvert is as deep as half the culvert diameter or at least one foot
  - —both ends extend a foot beyond the toe of the fill over the culvert
  - —the upstream & downstream end of the fill around the culvert is protected from erosion with rocks & seeded



OPEN TOP CULVERTS

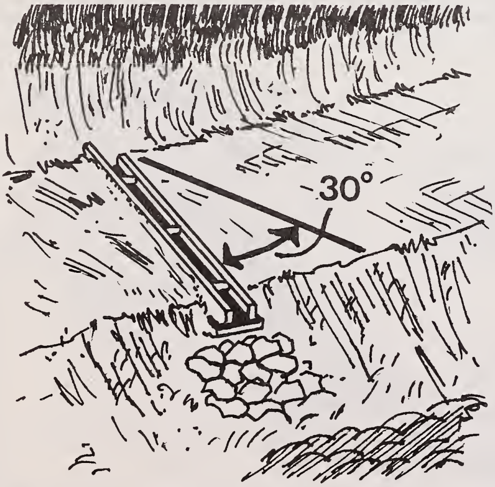
WHEN TO USE OPEN TOP CULVERTS

- Use open top culverts on low-cost haul roads to drain side ditches or to divert surface water running on the road itself
- Do not use open top culverts to handle streams
- Open top culverts clog up easily, so clean them regularly and do not use them on skid roads



HOW TO INSTALL AN OPEN TOP CULVERT

- Install the culvert at a 30 degree angle downslope
- Let the open outlet end extend beyond the road surface and place a broad apron of rocks or logs under it to spread the flow of water and trap sediment
- Let the inlet end extend into the cut slope or ditch
- Space culverts on long slopes at regular intervals:



MAXIMUM RECOMMENDED CULVERT SPACING

GRADE	ERODABILITY	
	Low	High
3%	—	1070'
4%	—	800'
5%	1200'	640'
6%	1000'	540'
8%	750'	400'
10%	600'	320'

EROSION CONTROL DEVICES

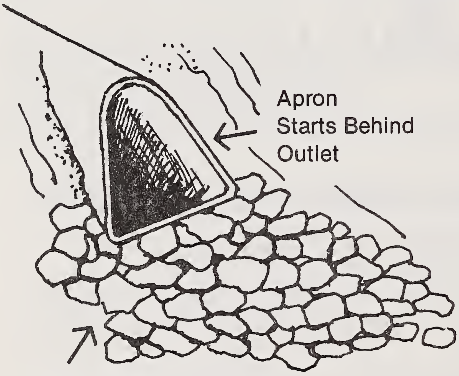
ENERGY DISSIPATERS

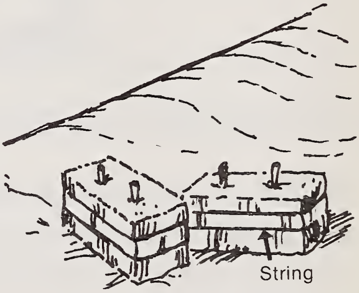
Rocks, logs, straw bales, or other devices can slow the flow of water & reduce erosion.

Energy dissipaters should be used on the downhill side of culverts & ditches.

HOW TO INSTALL

- Start rock aprons behind culvert outlet
- Rock aprons should cover an area twice the diameter of culvert
- Stake straw bales down with wood or steel fence posts & make sure strings are not on the ground

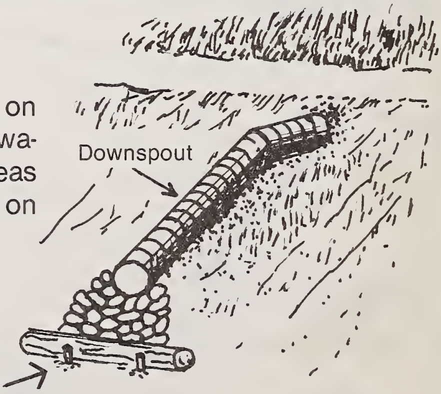




Straw Bale Sediment Trap
in Roadside Ditch

DOWN SPOUTS

Open or enclosed downspouts on culverts help in safely moving water off fill slopes & unstable areas when existing culverts are not on grade

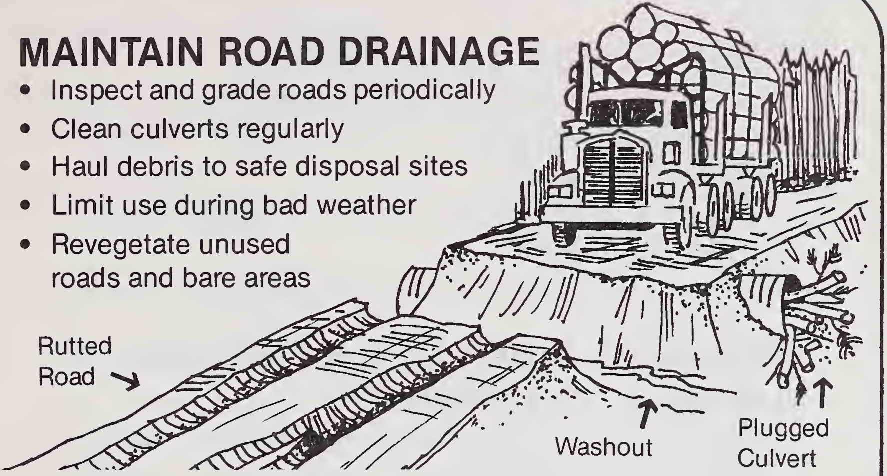


Rock Apron
&
Log Energy Dissipater

MAINTENANCE

MAINTAIN ROAD DRAINAGE

- Inspect and grade roads periodically
- Clean culverts regularly
- Haul debris to safe disposal sites
- Limit use during bad weather
- Revegetate unused roads and bare areas

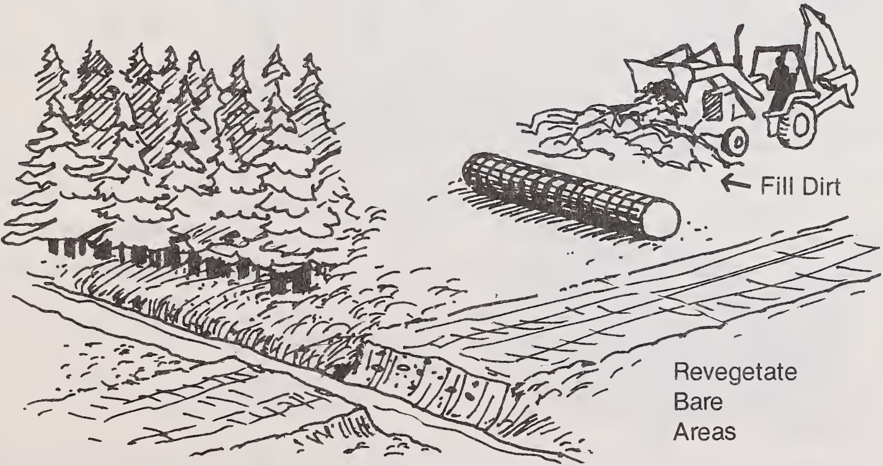


CULVERT REMOVAL

Remove culverts from temporary roads to prevent plugging & washout. Culverts can be reused.

HOW TO REMOVE CULVERTS

- Get a 310 Permit from your local Conservation District
- Carefully remove fill dirt using appropriate machinery (backhoe) or by hand
- Place fill dirt, culvert, and loose remains above high water level
- Revegetate streambanks & disturbed areas



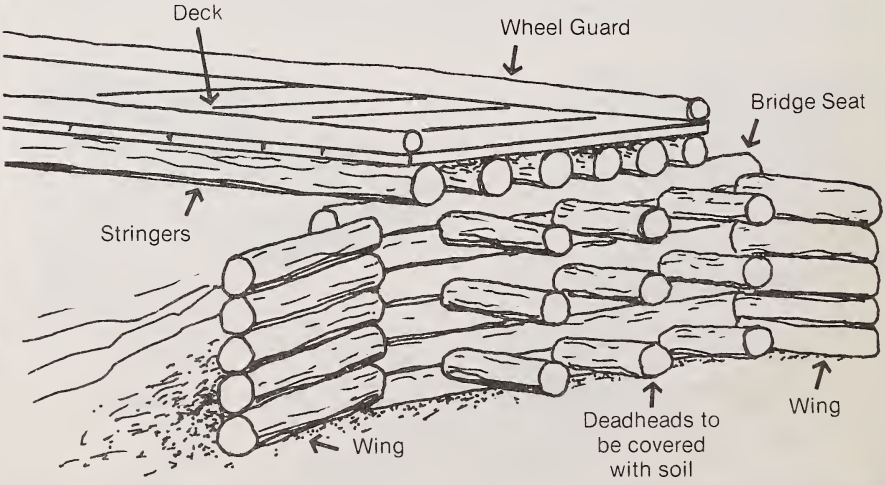
LOG BRIDGES

WHEN TO USE A LOG BRIDGE

- Log bridges make good stream crossings when a stream is too large or too steep for a culvert or when fish passage is a concern
- Obtain a 310 Permit from your local Conservation District

CONSIDERATIONS WHEN PLANNING A SIMPLE LOG BRIDGE

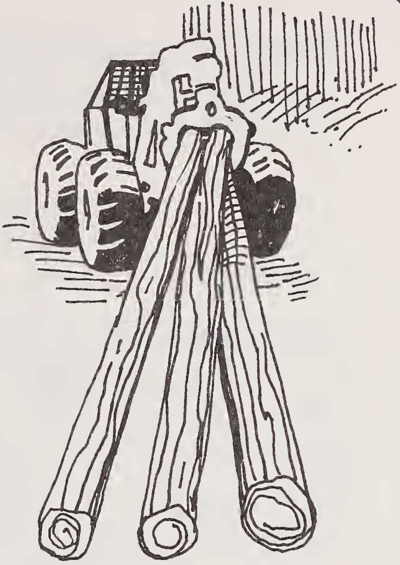
- Select a location where the stream channel is straight and unobstructed. Find stream banks that are firm and level and approaches that are not too steep; the road should cross at right angles to the stream
- Bridge span and clear height should handle expected peak runoff. Help in selecting proper size can be obtained from State Lands Office, Soil Conservation Service, or the local Fish, Wildlife, and Park Office
- Establish a firm footing for the logs, but prevent soil from falling into the stream. Log cribbing is best
- Do not gravel the deck. The gravel holds moisture that cuases the deck to rot
- Seed and mulch any disturbed areas outside the road bed so that erosion is minimized.



SKID TRAILS

MINIMIZE EROSION

Build skid trails that disperse surface water

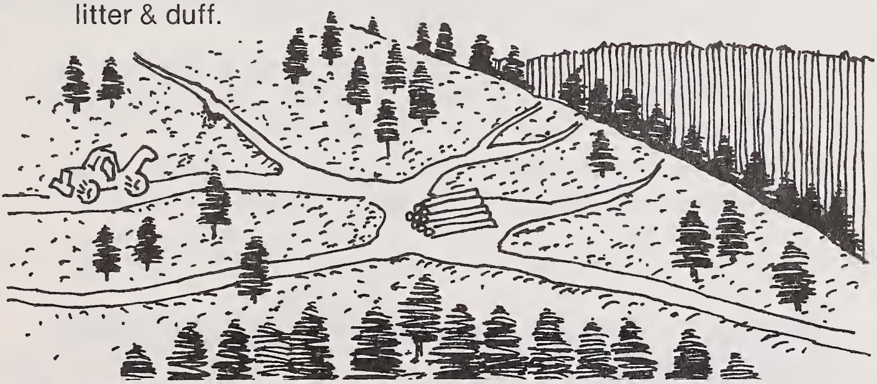


ON GENTLY SLOPING LAND

- On land that slopes no more than 10% (10 feet rise for every 100 feet) skid uphill where possible so water running in the pattern of skid trails is dispersed and not concentrated on the landing
- Suspend head end of logs to reduce gouging the soil

ON STEEP SLOPES

- On erodible slopes more than 30%, avoid skidding straight downhill for any distance. Install water bars to divert water into litter & duff.



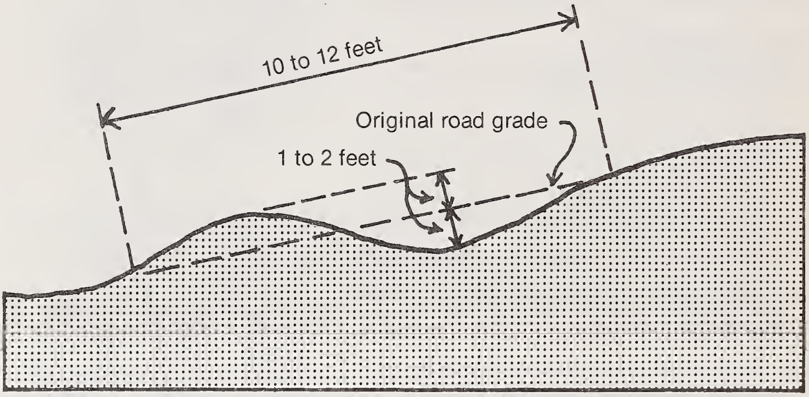
SLASH HELPS REDUCE EROSION

- Slash deposited in skid roads and trails breaks up as the skidder runs over it, packs into the soil, and retards erosion

WATER BARS

WHAT IS A WATER BAR?

Water bars are small earth dams in skid trails and roads that force water off the trail or road and into the woods

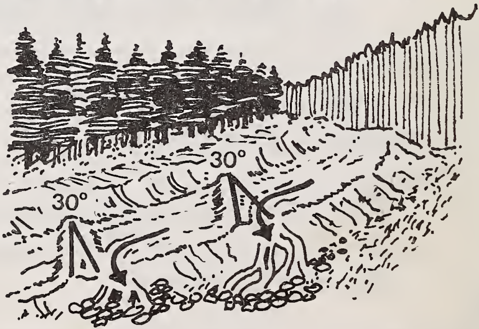


HOW TO INSTALL A WATER BAR

- Install bars with a skidder blade, dozer blade, or by hand
- Construct the bar so that it extends at least 12 inches above and 12 inches below the road surface
- Install the bar so it is at a 30 degree angle downslope
- Extend the bar into the side ditch or cut slope, so it intercepts water there
- Extend the outlet end of the bar beyond the edge of the road and place rocks, slash, or logs there to filter the run off

INSTALL WATER BARS AFTER LOGGING OPERATIONS

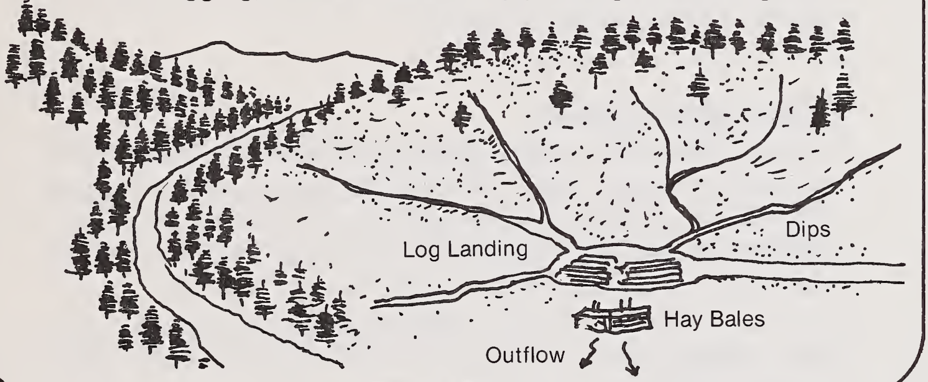
Water bars are installed on skid trails and some roads after logging operations are done or as a temporary measure after fall operations to limit erosion during spring runoff



LANDINGS

CONTROL THE DRAINAGE

- Locate landings on ground that allows good drainage
- Keep landings out of streamside management zones
- Avoid wet or unstable areas
- Use dips to keep skid trail water off landings
- Use hay bales to minimize erosion runoff
- After logging, stabilize the area by planting trees and grass



SLASH HAZARD REDUCTION

DISPOSAL & SCARIFICATION

- Slash disposal and scarification should be done when soils are dry
- Pile slash from streamside management zone by hand
- Avoid excessive scarification both in soil depth and surface area

SEEDING

SEEDING AND MULCHING HELPS REDUCE EROSION

Erosion on disturbed areas, such as landings or roads that are to be "put to bed," can be held in check by grass and legume seeding and/or mulching. Seeding and mulching on cut and fill areas near streams are especially important since erosion there causes excessive sediment delivery to streams. Seeding also provides wildlife habitat & forage.

SEED MIXTURES

The Soil Conservation Service & the Department of State Lands recommend various seed mixtures for seeding skid trails and disturbed areas. Generally, the seed can be broadcast. Fertilizer should be spread at the rate recommended by the manufacturer, the Soil Conservation Service or your Service Forester.

Mulching to prevent erosion before permanent vegetation can take hold also makes sense. Mulch with hay, cereal straw, bark, or native vegetation.

WATER QUALITY CHECKLIST

HRA# ____________________
Contractor ____________________
Landowner ____________________
Pre. Date ____________________
Int. Date ____________________
Post Date ____________________

____

I. SITE SITUATION

A. Stream drainages in harvest areas? Yes_____ No_____

B. Average side slope percent?____________________

C. Soil survey or landtype map erosion interpretations reviewed?

Yes_____ No_____

D. Proposed silvicultural system(s)____________________

E. Proposed harvest system(s)____________________

F. Downstream water uses: Drinking water_____ Stock water_____

Irrigation_____ Other_____

II. WATER QUALITY RECOMMENDATIONS:

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WATER QUALITY CHECKLIST

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II. WATER QUALITY RECOMMENDATIONS:

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The Department of State Lands has offices throughout Montana to provide forestry services to private forest owners and the wood products industry. For assistance or information concerning forest management, please contact one of the offices listed below.

Anaconda Unit Office
7916 Highway 10-A West
Anaconda, MT 59711
(7 miles west of Anaconda)
Telephone: 563-6078

Southern Land Office
1245 No. 29th Street
Billings, MT 59101
Telephone: 259-3264

Bozeman Unit Office
P. O. Box 1343
25 E. Mendenhall
Bozeman, MT 59715
Telephone: 586-5243

Choteau Unit Office
P. O. Box 156
17 Main North
Choteau, MT 59422
Telephone: 466-5820

Hamilton Unit Office
Ford Building
P. O. Box 713
Hamilton, MT 59840
Telephone: 363-1585

Helena Unit Office
8001 N. Montana Avenue
Helena, MT 59601
Telephone: 449-3637

Kalispell Unit Office
P. O. Box 490
Kalispell, MT 59901
(1 mile north of Kalispell)
Telephone: 755-6575

Missoula Unit Office
1401 27th Avenue
Missoula, MT 59801
Telephone: 728-4300

Libby Unit Office
P. O. Box 1106
Libby, MT 59923
Telephone: 293-8134

Swan River State Forest
Swan Lake, MT 59911
(12 miles south of Swan Lake
at Goat Creek)
Telephone: 754-2301

Plains Unit Office
P. O. Box 219
Plains, MT 59859
(1 mile west of Plains)
Telephone: 826-3791

Clearwater State Forest
P. O. Box 388
Greenough, MT 59836
(2 miles east of Clearwater Jct.)
Telephone: 793-5770

Stillwater State Forest
P. O. Box 164
Olney, MT 59927
Telephone: 881-2371

Eastern Land Office
P. O. Box 1794
Miles City, MT 59301
Telephone: 232-2034

Northeastern Land Office
613 N.E. Main Street
P. O. Box 1021
Lewistown, MT 59457
Telephone: 538-5989

DIVISION
OF
FORESTRY

DEPARTMENT OF STATE LANDS

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